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# **The Acoustical Oceanography of Bubbles: URI Component**

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## **LONG-TERM GOALS**

To develop a comprehensive account of the acoustical oceanography of bubbles in the ocean, including their formation, evolution and decay, their response to different oceanographic conditions, their contribution to passive sound in the sea, and their influence on acoustical propagation.

## **OBJECTIVES**

To write a monograph that will be of practical value to ocean acousticians and others concerned with bubbles in the sea. The monograph will include both oceanographic aspects and acoustical implications. The oceanographic discussion will cover bubble formation and injection and the response of bubble clouds to subsurface circulation, buoyancy effects and dissolution. The discussion of acoustical implications will cover the contribution of bubble formation to naturally occurring sound in the sea, the role of bubbles in scattering and absorbing sound, the acoustical characteristics of bubble plumes and clouds including the consequences of the evolution, and approaches to incorporating bubbles in acoustical propagation modeling.

## **APPROACH**

This is a collaborative effort being undertaken jointly with Dr Grant Deane of Scripps Institution of Oceanography. Our approach is to develop the overall focus of the monograph, identify topics to be covered and develop a plan for the contents of each chapter, followed by preliminary sketches of each chapter followed by detailed writing.

## **WORK COMPLETED**

Our effort this year has focused on writing sections on bubble generation and bubble behavior in the ocean, factors influencing bubble size distribution and bubble fluid dynamics. Following an introductory chapter on the scientific motivation for studying bubbles, bubble distribution, bubble creation mechanisms and bubble evolution detailed analysis of bubble creation and fragmentation in the presence of turbulence is described, including the formation of an initial bubble size spectrum. Figures have been assembled together with an extensive bibliography.

## **IMPACT/APPLICATIONS**

Bubbles have a profound impact on the upper ocean acoustical environment. Calculations requiring a knowledge of this environment, both with respect to naturally occurring sound and with respect to propagation such as sonar operations of various kinds, depend on a knowledge of bubble distributions and their oceanographic and acoustical behavior. This monograph is intended to summarize available knowledge on this topic and provide the theoretical framework required for relevant acoustical modeling.

## **RELATED PROJECTS**

Acoustical Oceanography of Bubbles: SIO Component